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ELECTRONIC DEVICES HAVING DISPLAYS WITH OPENINGS

This application is a continuation of U.S. patent application Ser. No. 13/273,851, filed Oct. 14, 2011, which is hereby incorporated by reference herein in its entirety. This application claims the benefit of and claims priority to U.S. patent application Ser. No. 13/273,851, filed Oct. 14, 2011.

BACKGROUND

This relates to electronic devices and, more particularly, to electronic devices with displays.

Cellular telephones and other portable devices often contain displays. Displays often occupy relatively large portions of an electronic device. For example, in an electronic device cellular telephone or tablet computer, a display may occupy the entire front face of the device.

In many device configurations such as those in which displays occupy large portions of a device, it can be challenging to accommodate device components within the device. For example, a display may present an obstacle to the installation and operation of device components. Unless care is taken, a designer may be forced to make aesthetically unappealing design choices or may need to install device components using awkward or bulky arrangements.

It would therefore be desirable to be able to provide improved arrangements for electronic devices with displays.

SUMMARY

An electronic device may have a display. The display may have an active region in which display pixels are used to display images. The display may be formed from a flexible display substrate such as an organic light-emitting diode display substrate or other display layers.

The display may have one or more openings. The openings may be organized in an array having rows and columns. The openings may be located in the active portion of the display.

The display may be mounted in a housing associated with the electronic device. An electronic component may be mounted in alignment with the one or more openings in the display. Signals associated with the electronic component may pass through the openings. The signals may include acoustic signals, electromagnetic signals such as radio-frequency electromagnetic signals, and light.

The electronic component may be a structure that uses light such as a camera, a light sensor, a light-based proximity sensor, a status indicator light, a light-based touch sensor array, or a secondary display that has display pixels that may be viewed through the openings.

The electronic component may also be a structure that uses radio-frequency signals such as an antenna. Antenna structures may, for example, include a near field antenna or other antenna structures.

The electronic component may be an acoustic component such as a microphone or speaker. A microphone may receive acoustic signals through the openings. Sound from a speaker may be emitted through the openings.

One or more openings in the display may form a window through which a user of the device may view an external object. Display pixels in the portion of the display in which the window is formed may be used in forming a heads-up display. With this type of configuration, the electronic device may display an image for the user using the display pixels

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in the window region while the user simultaneously views the external object through the window region.

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an illustrative electronic device with a display having an opening in accordance with an embodiment of the present invention.

FIG. 2 is a schematic diagram of an illustrative electronic device having a display with an opening in accordance with an embodiment of the present invention.

FIG. 3 is a cross-sectional side view of an illustrative electronic device having a display with an opening to accommodate signals associated with an internal electronic component in the device in accordance with an embodiment of the present invention.

FIG. 4 is a top view of a portion of an illustrative display having an opening in accordance with an embodiment of the present invention.

FIG. 5 is a top view of a portion of an illustrative display having multiple openings with curved edges organized in an array of rows and columns in accordance with an embodiment of the present invention.

FIG. 6 is a top view of a portion of an illustrative display having multiple openings with straight edges organized in an array of rows and columns in accordance with an embodiment of the present invention.

FIG. 7 is a top view of a portion of an illustrative display having an array of rectangular openings and display pixel structures and interconnects formed on structures surrounding the openings in accordance with an embodiment of the present invention.

FIG. 8 is a cross-sectional side view of an illustrative upper display with openings through which display pixels on a lower display may be viewed in accordance with an embodiment of the present invention.

FIG. 9 is a cross-sectional side view of an illustrative device with a display that has openings and an antenna mounted under the openings to communicate with external wireless equipment in accordance with an embodiment of the present invention.

FIG. 10 is a cross-sectional side view of an illustrative electronic device having a display with openings through which acoustic signals associated with one or more acoustic components may pass in accordance with an embodiment of the present invention.

FIG. 11 is a cross-sectional side view of an illustrative electronic device having a display with an opening that allows light to reach a camera in accordance with an embodiment of the present invention.

FIG. 12 is a cross-sectional side view of an illustrative electronic device having a display with an opening that allows light to reach a light sensor in accordance with an embodiment of the present invention.

FIG. 13 is a cross-sectional side view of an illustrative electronic device having a display with openings to accommodate a light-based proximity sensor in accordance with an embodiment of the present invention.

FIG. 14 is a cross-sectional side view of an illustrative electronic device having a display with openings to accommodate emitted light from light-emitting-diode status indicators in accordance with an embodiment of the present invention.